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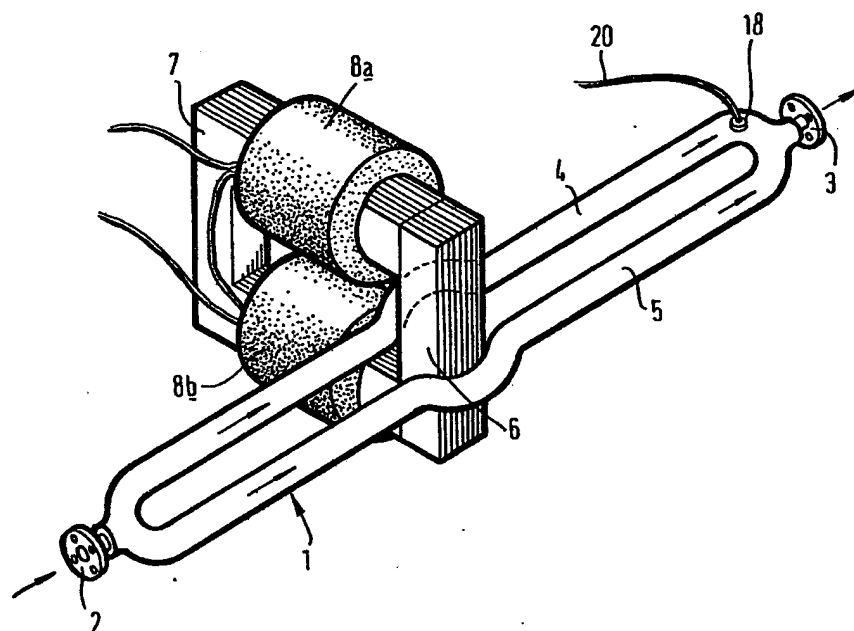
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(54) Induction heated conduit  
assembly e.g. a launder

(57) The assembly comprises a length of conduit 1 for conducting a fluid from an input 2 (e.g. at lead melting equipment) to an output 3 (e.g. at casting equipment) a substantial distance away. The conduit is divided into two fluid-conducting legs 4 and 5 at the input 2, which re-combine at the output 3. These legs form at least part of the secondary circuit of an induction heating system including a primary winding 8a, 8b, on a core 6 that passes between the legs 4 and 5. When power is supplied to the primary winding a high current is induced in the legs 4 and 5, which produces an essentially uniform heating effect along substantially the entire length of the conduit.

FIG.1



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FIG. 1.

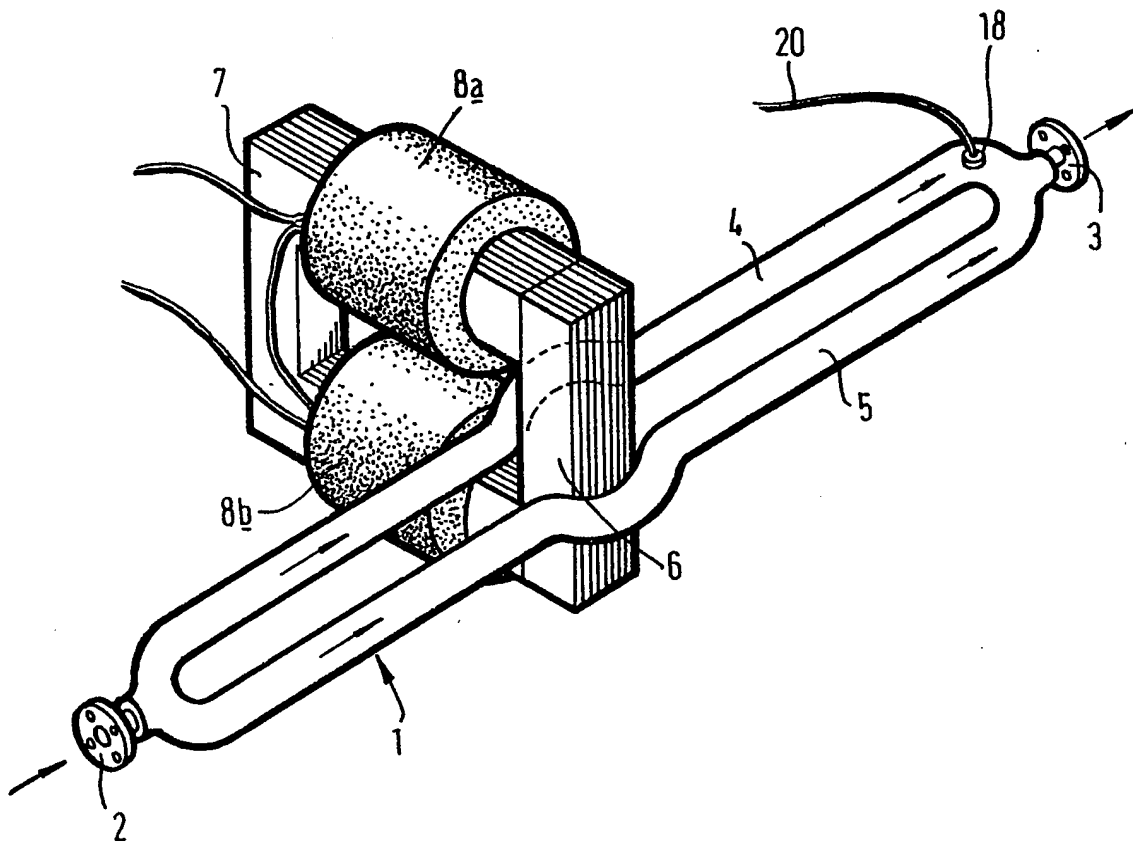
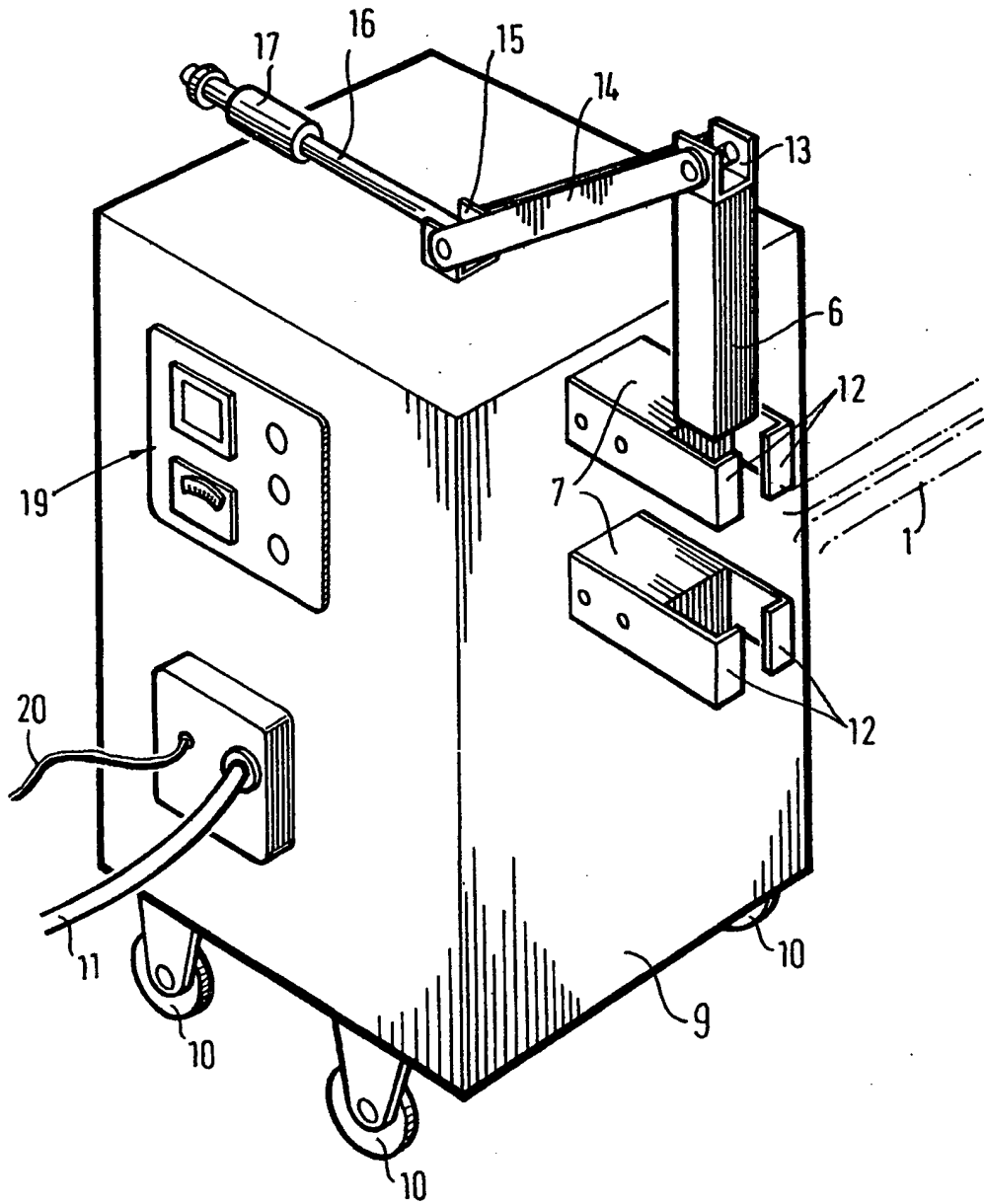


FIG. 2.



## SPECIFICATION

### Heated conduits

5 This invention is concerned with conduits which can be used for transferring a fluid such as molten metal from one place to another, for example between melting and casting equipment.

Such conduits are often required to be of a  
10 considerable length, sometimes 5 metres or more, and this inevitably involves a considerable heat loss. The conventional solution is to provide burners at intervals along the pipe run, but this makes lagging very difficult and much of the heat produced by the  
15 burners is lost to the surroundings. In addition, the heating is not evenly distributed along the length of the conduit. Another disadvantage of this solution is that the empty conduit cannot be preheated without a high risk of localized overheating, resulting in  
20 permanent damage to the conduit.

The aim of the invention is to overcome these drawbacks.

The invention basically provides a heated conduit assembly, comprising a length of conduit for conducting a fluid from an input at one end of the  
25 conduit (e.g. at metal melting equipment) to an output at the other end of the conduit and located a substantial distance from the input (e.g. at metal casting equipment), and a heating system for supplying heat to the fluid during passage through the  
30 conduit, the assembly being distinguished by the fact that

(i) the conduit is divided adjacent to the input to form at least two fluid-conducting legs which re-  
35 combine adjacent to the output, and

(ii) the heating system is an electrical induction heating system having a primary input winding and a secondary circuit which incorporates the legs of the conduit.

40 Since electrical heating is employed as opposed to a naked flame, lagging can be achieved much more conveniently. Furthermore, the heating effect can be distributed evenly along almost the entire length of conduit and the empty conduit may be preheated  
45 with relative safety.

The legs of the conduit preferably run in close proximity to each other along a substantial portion of their length to minimise heat loss and to facilitate lagging.

50 The legs preferably take a substantially direct route from input to output, taking account of any obstacles that they may encounter.

It is preferred for the legs to be of substantially equal length in order to equalise the heating effect in  
55 both legs.

The legs preferably form the whole of the secondary circuit so that the heat generated in the secondary circuit can be put to maximum use.

The primary winding is preferably coupled to the  
60 secondary circuit by a magnetic core, preferably in the form of a closed loop threading the primary winding and the secondary circuit. The primary winding and magnetic core may be carried by a mobile unit which is separate from the conduit, the  
65 core being split to facilitate withdrawal from the

conduit.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings, in which:

70 *Figure 1* shows the basic conduit assembly, and *Figure 2* shows the heater unit of the assembly in more detail.

The assembly comprises a length of conduit 1 having an input 2 for connection to lead melting apparatus or such like, and an output 3 for connection to suitable casting equipment. The conduit is approximately 5 metres in length and is divided adjacent to the input connection 2 to form two essentially straight and parallel legs 4 and 5 of  
80 substantially equal length and diameter, which recombine adjacent to the output connection 3. The conduit is formed of electrically conductive material.

About mid-way along the conduit the spacing between the legs 4 and 5 is increased to receive a  
85 link 6 of a rectangular laminated iron core 7. The increased spacing permits a larger core to be used whilst at the same time keeping the legs 4 and 5 as close together as possible for optimum heat retention. The two sides of the core 7 adjacent to the link 6  
90 carry a split primary input winding 8a, 8b, of between one hundred and several thousand turns of copper wire. This split primary arrangement is more efficient than a single primary winding since it provides better coupling with the secondary circuit  
95 formed by the legs 4 and 5, although a single winding could be used if desired.

As shown in *Figure 2*, the majority of the core 7, including the primary winding 8a, 8b, is enclosed within a trolley-mounted cabinet 9 which is provided  
100 with swivel castors 10 for ease of movement. The castors have a brake for holding the cabinet in the operating position adjacent to the conduit 1. Power is supplied to the primary winding from the single-phase 50Hz mains via a cable 11.

105 The link 6 is capable of being lifted out of its operating position shown in *Figure 1*, to permit the heater unit to be removed from the conduit for maintenance etc. The exposed ends of the core 7 are provided with L-shaped guides 12 for the link 6. The  
110 upper end of the link carries a U-shaped bracket 13 which is pivoted to a pair of parallel linkages 14, which are in turn pivoted to further U-shaped bracket 15 mounted on top of the cabinet 9. An operating handle 16 is rigidly coupled to the linkages 14 and carries a weight 17 to counter-balance the weight of the link 6. The handle 16 also operates a switch (not shown) which acts as an electrical interlock to ensure that power can only be supplied to the primary when the link is in its operating position.

120 A temperature sensor in the form of a thermocouple 18 (*Figure 1*) is mounted on the conduit, preferably near the output end 3, to measure the wall temperature. The thermocouple is connected to an automatic temperature control panel 19 on the  
125 cabinet 9 via a lead 20.

A further temperature sensor (not shown) such as a thermocouple could be mounted inside the conduit, preferably near the output end 3, to monitor the fluid temperature. Signals from this sensor are fed to the temperature control panel 19 via a suitable

connecting lead (also not shown).

When it is required to preheat the empty conduit, power is supplied to the primary winding and a heavy current is induced in the legs 4 and 5 which act

- 5 as a single shorted turn around the link 6. This current generates heat in the legs which is distributed substantially uniformly along their length resulting in a considerably reduced risk of overheating. When molten metal is passed through the  
10 conduit the heat generated by the current is transferred from the walls of the conduit to the metal, keeping it within the required temperature range. The conduit can be lagged very effectively, although for clarity no lagging is shown in the drawings. The  
15 automatic temperature control system ensures that power is only supplied to the primary winding when the sensed temperature falls below a predetermined level, thus conserving power. This control system also acts as an additional safeguard against over-  
20 heating during the preheating process.

The assembly could also be used with other liquids or gases, either to maintain the temperature of the liquid or gas above ambient, or indeed, to raise its temperature during transfer through the  
25 conduit.

- It is not essential for the conduit to be formed in one piece as shown. For example, the legs could be electrically insulated individually from the input and output connections and their ends joined by electric-  
30 ally conductive straps. Furthermore, the link 6 could pass between the legs 4 and 5 at any position along their length. If a thinner core is used no increase in spacing around the core would be necessary. A single core could be used to heat more than one  
35 conduit simultaneously.

The assembly could be adapted to work from a three-phase supply by dividing the conduit into three legs and providing a suitable core arrangement.

#### 40 CLAIMS

1. A heated conduit assembly, comprising a length of conduit for conducting a fluid from an input at one end of the conduit (e.g. at metal melting  
45 equipment) to an output at the other end of the conduit and located a substantial distance from the input (e.g. at metal casting equipment), and a heating system for supplying heat to the fluid during passage through the conduit, the assembly being  
50 distinguished by the fact that

(i) the conduit is divided adjacent to the input to form at least two fluid-conducting legs which recombine adjacent to the output, and

- (ii) the heating system is an electrical induction  
55 heating system having a primary input winding and a secondary circuit which incorporates the legs of the conduit.

2. An assembly according to Claim 1, in which the legs of the conduit run in close proximity to each  
60 other along a substantial portion of their length.

3. An assembly according to Claim 1 or 2, in which the legs of the conduit take a substantially direct route from input to output.

4. An assembly according to any preceding  
65 claim, in which the legs are of substantially equal

length.

5. An assembly according to any preceding claim, in which the legs form the whole of the secondary circuit.  
70 6. An assembly according to any preceding claim, in which the primary winding is coupled to the secondary circuit by a magnetic core.  
7. An assembly according to Claim 6, in which the core is a closed loop threading the primary  
75 winding and the secondary circuit.  
8. An assembly according to Claim 7, in which the core passes between the legs of the conduit.  
9. An assembly according to Claim 8 as appended to Claim 2, in which the spacing between  
80 the legs is increased to receive the core.  
10. An assembly according to any of Claims 7 to 9, in which the core is split enabling it to be removed from the secondary circuit.  
11. An assembly according to Claim 10, in which  
85 the core is split so as to form a removable link, guides being provided for the link so that it can be slid out of its operating position.  
12. An assembly according to Claim 11, in which the link is arranged to operate an electrical interlock  
90 which ensures that power can only be applied to the primary winding when the link is in its operating position.  
13. An assembly according to any of Claims 10 to 12, in which the primary winding and magnetic core  
95 are carried by a mobile unit which is separate from the conduit.  
14. An assembly according to any preceding claim, which also comprises a temperature control system including a temperature sensor for measuring the wall temperature of the conduit, the control  
100 system being arranged to apply power to the primary winding only when the sensed temperature is below a predetermined level.  
15. An assembly according to Claim 14, in which  
105 the temperature sensor is located near the output end of the conduit.  
16. An assembly according to Claim 14 or 15, in which the control system includes a further temperature sensor for monitoring the temperature of the  
110 fluid in the conduit.  
17. An assembly according to Claim 16, in which the further sensor is located near the output end of the conduit.  
18. A heated conduit assembly which is substantially as described with reference to the accompanying  
115 drawings.